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Notes On Tropical Diseases for Air Corps Medical Officers

PREPARED BY THE MEDICAL SECTION

U.S. ARCTIC, DESERT AND TROPIC INFORMATION CENTER

NOTES ON TROPICAL DISEASES FOR AIR CORPS MEDICAL OFFICERS

The war against the Axis in the tropics and subtropics will not be won by the United Nations unless disease in these theaters of operations is controlled. In wartime, a great burden is placed on the medical department, but never before has military success been so dependent on medical success.

The medical problem is the control of tropical diseases. This is a tall order, but is not as impossible as it might seem at first glance, for analysis reveals that in general it can be narrowed down to the control of three routes of infection:

I. **Mosquitoes-** vectors of malaria and dengue

II. **Food and Water-** the vehicle for transmission of dysentery, amebiasis, typhoid, cholera and intestinal parasites

III. **Breaks of the Skin Surface-** as a route for severe skin infections

In general, all other tropical diseases are of minor importance, in so far as they will affect the outcome of the war.

PART I
MOSQUITOES

Mosquitoes are the vectors of two important diseases, *malaria* and *dengue*.

A. MALARIA

Malaria is the chief problem. Without the aid of the Axis-discovered drug, atabrine, defeat of Japan would be much more difficult, for Japan's conquest of Java gave her 90% of the world's production of quinine. Without quinine or atabrine, the United Nations could not fight the Japs in Guadalcanal, New Guinea, or Burma. In these areas, malaria is a greater menace than Jap bullets.

Geographic Distribution

Malaria occurs between latitudes 45°N and 40°S. The area of military importance is more limited. Malaria is a major military problem in South America, the Indies, Africa, the Middle East, India, Burma, Thailand, Indo-China, China and Malaya. It does not occur in Pacific Islands east of 170°E or south of 20°S. This means that the majority of United Nations-held islands are malaria-free, while Japanese-held islands are malarious.

Cause of Malaria

Malaria is caused by plasmodia.

Two types are of major military importance:

1. *Plasmodium vivax*, the cause of benign tertian malaria.
2. *Plasmodium falciparum*, the cause of malignant tertian malaria.

Two types are of minor military importance:

1. *Plasmodium malaria*, the cause of quartan malaria.
2. *Plasmodium ovale*, similar to benign tertian.

The predominant type varies in different areas.

Life History of the Plasmodium

Plasmodia have both an asexual and a sexual cycle. Human infection is initiated by an asexual form of the plasmodium, and the periodicity of malaria is associated with this asexual cycle. The asexual multiplication of plasmodia in the human is accompanied by the development of sexual forms (gametocytes). These are the only forms capable of infecting the mosquito, and when drawn in blood by the mosquito, initiate the sexual cycle. Asexual forms develop in the mosquito in about ten days, and the mosquito is then infective for man.

Transmission

The female anopheline mosquito transmits the disease from an infected human to a susceptible human.

Not all anopheline mosquitoes transmit malaria, and a potent vector in one area may be harmless in another area.

Habits of the Anopheline Mosquito

1. Anopheline mosquitoes bite between dusk and dawn.
2. In dense jungle or in dark rooms mosquitoes may bite during the day.
3. Mosquitoes rest in the daytime in dark corners of buildings or in the shade of foliage.
4. Mosquitoes breed in water. The type of water varies with each species of mosquito and may be salt or fresh, flowing or stagnant, clean or dirty, in large reservoirs or in small puddles. Specific breeding habits will be discussed in the appended "Regional Studies" devoted to mosquitoes prevalent in each area.

Epidemiology

1. The following three factors are required for the spread of malaria:

   a. Infected humans with gametocytes in the peripheral blood
   b. Susceptible humans
   c. Efficient anopheline vectors

2. *Seasonal Variation.* Malaria morbidity varies according to the effect of the weather on the breeding habits of the mosquito. In the tropics the incidence is highest, usually, at the beginning and toward the end of the wet season.

3. *Altitude.* Malaria is usually rare at altitudes above 5,000 feet. However, this does not always apply; severe epidemics have been

reported from areas as high as 8,000 feet above sea level.

4. *Race.* Natives of malarious areas appear to be more resistant to malaria than individuals having had no previous contact with the disease. The probable reason may be found in recurrent attacks in the native child causing either death or development of tolerance to the disease.

5. *Incidence.* Many tropical areas have no malaria, because of the absence of suitable mosquito vectors.

Malarious regions may be divided into three categories, depending upon the incidence in the native population. This can be assessed roughly by examining the natives for splenomegaly and compiling a splenic index:

a. *Endemic*, with splenic index up to 10 per cent
b. *Highly endemic*, with splenic index 10 to 40 per cent
c. *Hyperendemic*, with splenic index over 40 per cent

In the same operational area all three regions may be present only a few miles apart. It is axiomatic that flying fields should be located where the rate is low. Even with good anti-malarial measures, troops operating in highly endemic or hyperendemic areas may experience an incapacitating morbidity.

Symptoms of Malaria

BENIGN TERTIAN

This is the most prevalent infection of temperate and subtropical zones. The average incubation period is 14 days, although there is considerable variation. Usually the onset is fairly rapid with a slight headache and general malaise giving way to a severe chill. The chill lasts from 20 to 60 minutes, during which time the temperature rises. It is followed by the hot stage in which headache is severe and nausea and vomiting occur; frequently herpes appears around the lips, and there may be pain in the region of the spleen. The temperature rises to 104°F. or 105°F., the pulse is rapid and bounding, the face flushed, the skin hot and dry. This stage lasts one to four hours, and is followed by the sweating stage. The duration of the sweating stage is four or more hours. The temperature falls rapidly, the patient feels better but washed out, thirst is marked, and headache disappears. After one well day the paroxysm is repeated. The classical onset with a chill often does not occur and symptoms may be indefinite, namely general malaise and slowly rising temperature.

QUARTAN MALARIA

The symptoms are the same as in benign tertian malaria but there are two well days between each paroxysm. The incidence is generally low, but the disease may be prevalent in certain areas.

MALIGNANT TERTIAN MALARIA

This is the most prevalent infection of tropical areas. There are four main types:

1. *Remittent Fever*
2. *Cerebral*
3. *Algid*
4. *Bilious Remittent*

1. *REMITTENT FEVER*

This is the most common type. The onset is insidious, without frank chilling, but with a chilly sensation followed by a rise in temperature which becomes continuous or high remittent. Malaise is profound, headache and backache severe, and the face flushed. There may be nausea and vomiting. Collapse resembling that seen in typhoid fever may appear. Splenomegaly occurs early. Paroxysms may last 20 to 36 hours, showing some periodicity, or may be continuous due to the onset of a new paroxysm before the first has terminated. Blood examination may be of little help. Ring forms may be found in the peripheral blood during a fever, but more often parasite-containing red cells are held in the reticulo-endothelial system and cannot be demonstrated on blood films.

2. *CEREBRAL FORMS*

In a malarious district, any man brought in unconscious from other than obvious trauma should be considered to have malignant tertian malaria and treated immediately. The symptoms may resemble diabetic coma, uremic coma, encephalitis, meningitis, or a variety of other conditions. Unless treatment is adequate and immediate, the mortality will be about 50 per cent. The predominant features often are hyperpyrexia, delirium, convulsions, various types of hemiplegia or psychosis, including one resembling acute alcoholism. It is hard to distinguish the hyperpyrexial malaria from heat stroke, since the only symptom may be a rapid rise in temperature, even up to 110°F. Unless this type is treated at once, coma followed by death is to be expected.

3. *ALGID*

The algid manifestations of malignant tertian malaria may resemble any acute abdominal condition, but the most common forms are dysenteric and choleric.

In dysenteric algid there is sudden onset of abdominal pain and frequent stools containing blood and mucus. The symptoms may be very severe, with rapid dehydration, prostration and death.

Choleric algid may produce all the symptoms of cholera: vomiting, diarrhea, cramps in abdomen and legs, scanty urine, collapse, and a cold clammy skin. Coma and death may supervene rapidly.

4. *BILIOUS REMITTENT*

This type resembles blackwater fever, but is much less severe, the patient exhibiting nausea, vomiting and bile-loaded stools. Jaundice appears on the second day. Bile is present in the urine and blood. There may be an enlarged tender liver; sometimes hematemesis will occur.

RELAPSES

Adequate treatment will reduce the relapse rate, but even then relapses will occur. They are most frequent in quartan and least frequent in malignant tertian. Often it is hard to distinguish a relapse from a reinfection. In general a relapse is less severe and more easily controlled.

BLOOD EXAMINATION

Whenever possible, Medical Officers should secure laboratory facilities. Do everything possible to get a microscope for personal examination of blood films. It may be possible to train a conscientious E. M. to examine films for malaria. (See Appendix for technic.)

Treatment *(From SGO Circular Letter 153.)*

UNCOMPLICATED MALARIA

1. The method of choice is to use atabrine alone. Recommended dosage: atabrine hydrochloride 0.2 gram (3 grains) and sodium bicarbonate 1 gram (15 grains) by mouth with 200 to 300 cc. of water (or equal amount of sweetened tea or fruit juice) every

six hours for five doses, followed by 0.1 gram (1½ grains) three times a day after meals for six days (total 2.8 grams in seven days).

2. If atabrine is not available, use quinine alone, as follows: quinine sulfate 1 gram (15 grains) by mouth three times a day after meals for two days, followed by 0.6 gram (10 grains) three times a day after meals for five days (total 16 grams in seven days).

3. Plasmochin may be given in connection with either of the above treatments; however, its routine use is not advised. If plasmochin is given, the patient must be hospitalized and closely observed. The dosage given below should not be exceeded. Plasmochin may be given immediately following atabrine (not with it) or along with quinine on the last days of treatment with that drug. The course consists of plasmochin 0.01 gram (1/6 grain) by mouth three times a day after meals for four days, except for the debilitated patient who should receive only two doses a day. Each dose of plasmochin should be accompanied by at least 1 gram (15 grains) of sodium bicarbonate. The fluid and sugar intake should be liberal during and for some days after the course. *Discontinue plasmochin at once, if any toxic symptoms appear.*

SEVERE MALARIA, or malaria complicated by vomiting, coma, or other serious disorders.

In these cases, and whenever a patient cannot retain or fails to respond to oral medication, atabrine or quinine should be given parenterally by one of the methods described below.

1. If *vomiting* is present, take general measures to control it. Do not allow solid food just before a febrile paroxysm is expected. If there is nausea or vomiting, sips of alkaline water may be helpful. If vomiting is frequent and troublesome, the intravenous administration of 5 per cent glucose in physiological saline solution is indicated, inasmuch as many patients who vomit become dehydrated and develop acidosis. From 200 to 400 cc. may be injected by the usual technique; this injection may be repeated if necessary, or larger amounts may be given by the continuous drip method (at the rate of 50 drops per minute). When glucose is administered in this way, it should be supplemented with 1 milligram of thiamine hydrochloride for each 25 grams of glucose.

2. *Coma* may be present or imminent in cases of *P. falciparum* infection, even though parasites are not found in the blood smear. This condition constitutes a grave emergency. On reasonable suspicion of the diagnosis, parenteral treatment must be immediately

instituted. The intravenous administration of quinine as described below, is preferable in the light of present knowledge, but it is possible that the intramuscular injection of atabrine is equally effective.

Recommended parenteral methods are as follows:

a. Atabrine dihydrochloride 0.2 gram (3 grains) in 5 cc. sterile distilled water injected *intramuscularly* with the usual precautions into each buttock (total 0.4 gram or 6 grains). If necessary, one or two additional doses of 0.2 gram (3 grains) may be given intramuscularly at intervals of six to eight hours. As soon as the patient can take and retain oral medication, atabrine should be given by mouth in such doses as to give a total by both routes together of 1.0 gram in forty-eight hours, followed by 0.1 gram three times a day after meals for five days (total 2.8 grams in seven days).

b. Quinine dihydrochloride 0.6 gram (10 grains) in sterile physiological saline 300 to 400 cc. (minimum 200 cc.) injected *intravenously* with the usual precautions, especially *avoiding speed.* If necessary, there should be no hesitation to cut down to the vein. This treatment may be repeated in six to eight hours, if the situation demands it. When the patient can take and retain oral medication, give a complete course of atabrine (preferable) or quinine by mouth as described for uncomplicated cases.

Note: In emergencies, when atabrine and quinine for parenteral use are not available, quinine sulfate may be given by rectum, using a dose of 1 or 2 grams mixed with a starch paste, thin enough to run through a rectal catheter. This route should not be used more than once or twice.

General Care

1. Keep the patient in bed. Maintain fluid intake at 3 to 4 liters per twenty-four hours, using the intravenous route if necessary. Since many patients with malaria may lose a great deal of salt, be sure that the intake of salt is adequate, giving supplementary amounts as may be indicated. Relieve chills by hot water bags and blankets. Relieve high fever by cold sponges and packs (avoid antipyretics). If a sedative is necessary, use one of the barbiturates. In all cases of *P. falciparum* infection, observe the patient closely for signs of cerebral or circulatory collapse.

2. Patients with clinical malaria or parasitemia should be in screened wards or under mosquito bed nets (with care that they do not

sleep against the nets).

3. In convalescence give a generous high vitamin diet, together with ferrous sulfate 0.6 gram (10 grains) three times a day after meals for at least two weeks (preferably longer).

General Discussion of Therapy

1. Quinine supplies are limited. Conserve supplies by using atabrine-plasmochin treatment in the milder cases.

2. Intravenous quinine must be used cautiously for it may produce rapid collapse and death, especially in acutely ill patients.

3. Neoarsphenamine (0.15 gm) given intravenously often produces surprisingly good results. Use it as an adjuvant to atabrine or quinine, giving one injection as soon as the diagnosis is made. The usual contraindications to the use of arsenicals apply.

4. In the absence of specific antimalarial drugs, full doses of sulfathiazole may reduce the severity of the symptoms.

5. Pilots and other air crew personnel should not be returned to duty for at least two weeks after completion of treatment. The first flight to high altitude should be made as co-pilot, since a relapse may occur at altitude.

The following table shows the effectiveness of the various drugs:

Type of Malaria	Phase in Man	Quinine	Atabrine	Plasmochin
Tertian	Asexual Sexual (Gametocytes)	Effective Ineffective	Effective Ineffective	Effective Effective
Malignant Tertian	Asexual Sexual (Gametocytes)	Very Effective Ineffective	Effective Very Ineffective	Very Ineffective Effective
Quartan	Asexual Sexual (Gametocytes)	Effective Ineffective	Effective Ineffective	Effective Ineffective

Control of Malaria

Antimalarial units organized by ASF may not be available to outlying posts, landing strips and aviation engineers. Responsibility then rests with Flight Surgeons and other medical officers to advise the Commanding Officer and supervise control measures. Such measures vary according to the local incidence of malaria. In highly endemic or hyperendemic areas, antimalarial measures must be strictly applied.

Control of malaria will be discussed under the following three heads:

1. The *MAN*
2. The *PARASITE*
3. The *MOSQUITO*

I. The Man

a. *EDUCATION*

(1) Medical officers must have full understanding of clinical malaria and its military importance.

(2) Medical officers must educate officers and men in the personal and military significance of malaria. Ignorance, superstition and preconceived ideas must be corrected.

b. *LOCATION OF CAMPS*

(1) When possible, locate camps at least one mile up wind from native villages and mosquito breeding places.

(2) When the site of a native village is used, control all natives. See paragraph two (*The Parasite*) below.

c. *BUILDINGS*

Screen all buildings with standard 18 mesh copper wire. Inspect screens regularly. Use mosquito netting on tents. Where supplies of screens are limited, use those available for messes, recreation quarters and hospitals. In highly malarious areas, provide double screen doors 6 feet apart, swung on opposite hinges. Both doors should open out and have automatic closure devices. Reduce entrances to a minimum. Baths, showers, and latrines for use after dark should be screened.

d. *CLOTHES*

Long trousers and shirts with sleeves rolled down are compulsory from half hour before dusk to half hour after dawn. Night shift ground crews and guards must be provided with headnet and gloves and with mosquito repellent. Pilots on night operations, while traveling between quarters and planes, must use protective measures. During night air raids, personnel taking shelter in slit trenches must be clothed, and exposed skin smeared with mosquito repellent.

e. *BED NETS*

Issue bed nets to all personnel prior to arrival in a malarious district. Take nets down and fold each morning, then put up each evening 30 minutes before dusk. The technic for correct use of bed nets should be demonstrated to all personnel. Overhead frames should be provided for nets. The lower edge must be tucked in so that no mosquitoes can enter. Mosquitoes will bite through the mesh where an individual touches the net. Arrange frames so that the net is held away from the edge of the bed. Spray the inside of nets before getting in at night. Make arrangements for replacement of worn nets. Make nightly bed net inspection tours.

f. *WORKING HOURS*

Advise the Commanding Officer that in areas with high malarial incidence, working man hours will be conserved by a reduced work day. Whenever possible, reveille should be 30 minutes after dawn; 30 minutes before dusk all personnel other than those on duty should be inside a screened building or under a bed net. Ground crews working on planes at night require all possible protection.

g. *BLOOD TESTS*

Where laboratory facilities are available, regular weekly blood smears should be done on flying personnel, and especially fighter pilots. This procedure may reveal pre-clinical infections. All flying personnel with a positive blood smear should be grounded and treated.

h. *CHEMICAL PROPHYLAXIS*

No drug will prevent malaria, but atabrine and quinine are useful for suppression. There is no reliable evidence that atabrine will impair pilot efficiency or limit altitude

tolerance. Mild disagreeable reactions from atabrine may occur in a small percentage of individuals, but will usually disappear if the drug is continued. The symptoms may be nausea, abdominal cramps or occasional headache, vomiting or diarrhea. Sodium bicarbonate or a sweet drink taken with the atabrine helps prevent these symptoms. Yellow discoloration of the skin does no harm and is no indication for discontinuing the drug. Quinine prophylaxis should be used only for those individuals who cannot tolerate atabrine. Quinine may produce unpleasant buzzing in the ears.

In areas with low malarial incidence, where the tactical situation is not urgent and where anti-mosquito measures are adequate, chemical prophylaxis is unnecessary. In the presence of a tactical emergency, atabrine suppression should be instituted so that troops, even though infected, can fight. When the emergency is over, atabrine suppression should be stopped and malaria cases treated as they appear. Where malaria is highly endemic or hyperendemic, all personnel should be given atabrine while in the area and during the season of high incidence. The dosage varies. In areas of low endemicity give 0.05 gram of atabrine nightly and 0.10 gram on Sunday. In highly endemic or hyperendemic areas give 0.1 gram six days a week after supper. Enforce rigid supervision to ensure that atabrine is taken.

2. The Parasite

a. *SOURCE*

(1) Avoid the source of the parasite, namely the natives. Locate camp away from native villages. Do not permit any personnel to visit villages between dusk and dawn. Clear camp of all native workers before dusk.

(2) Prevent transmission from infected personnel by adequate treatment and segregation of cases under bed nets in screened wards.

3. The Mosquito

a. *INSECTICIDES*

Insecticides may be obtained through the QMC. Freon-pyrethrum aerosol is the most efficient, and various types of pressure-cans and cylinders are available. One pound of freon-pyrethrum mixture is sufficient for about 150,000 cubic feet of space. About four seconds spraying is sufficient

for 1,000 cubic feet in military quarters, and six seconds for native huts. Hand atomizers and portable sprayers should be procured. Issue in addition at least one flit gun to every twenty men.

(1) Spray thoroughly all tents and buildings twice a day, at dusk and dawn.

(2) Spray the inside of planes used in night operations.

(3) Spray slit trenches, guard houses, etc., at dusk and again at midnight.

(4) Spray native huts twice a week.

(5) Convoy vessels at infected ports should anchor for the night at least one mile off shore. When this is impossible, spray all quarters and use mosquito nets.

(6) Spray the inside of railroad cars and trucks two or three times each night when traveling through a malarious zone.

b. *MOSQUITO RESTING PLACES*

(1) Whenever possible, remove vegetation around camp, especially at the edges of lakes, swamps and rivers, where mosquitoes rest in the shade during the day.

(2) Keep slit trenches free from grass and undergrowth.

c. *LARVAL CONTROL*

In the absence of organized units, comprehensive larval control will be difficult. Whenever possible the following measures should be carried out:

(1) Police camp thoroughly once each week for breeding areas such as rain gutters, water barrels, tin cans and coconut husks.

(2) Drain breeding grounds; spray breeding areas with larvicide. Waste motor oil mixed with three times the volume of kerosene is quite efficient. Portable sprayers are available and may be operated by one man. The capacity is four to five gallons and the spraying range about 25 feet. Paris Green mixed with road dust, one to five dilution, is effective against anopheles larvae.

It is sprayed through a hand-operated blower from the windward side of the breeding area. When the water is clear, about one-half ounce of Paris Green mixed with 99 parts of dust by volume is sufficient for 1,000 square feet of water surface.

B. DENGUE

Dengue is a disease of great military importance. Although the mortality is usually low and the disease of short duration, an explosive epidemic may incapacitate any military organization.

Geographic Distribution

Dengue may occur in epidemic form in almost any part of the tropical and subtropical world. In most tropical areas the disease occurs at the end of the rainy season. The incidence is usually highest in coastal regions and river deltas. In certain areas, dengue-like fevers, usually sporadic, may appear in epidemics. This group includes sand fly fever, Rift Valley fever, and five day fever in the Dutch East Indies.

Cause

A filterable virus is the cause of the disease. It can be found in the patient's blood on the last day of the incubation period and for three or four days thereafter, during which time the patient is infective for the mosquito.

Transmission

The vector is *Aedes aegypti*. In certain areas, *Aedes albopictus* may be the sole or an additional transmitting agent.

Mosquito Habits

Aedes aegypti is a domestic mosquito. It prefers to live and breed near human habitation. Any small puddle of water, or water standing in old tin cans, bottles, flower pots, vases, rain gutters, cisterns, or coconut husks, serves as a breeding place. The eggs are resistant to drying.

Only the female feeds on blood, biting mostly during the daytime, rarely at night. Its flight range is limited to a few hundred yards.

Symptoms

The incubation period is five to nine days (limit 4-15 days). The onset is sudden, with muscular and joint pains, backache, malaise and

anorexia. There is usually intense supraorbital and postorbital aching, with sharp pain on moving the eyes. Mental depression is often marked. The pulse may be rapid, but most often is slow. Lymphadenopathy may appear. Frequently a transient blotchy rash occurs on the face. There is a rapid rise of temperature to 102° - 105°F. The temperature drops to normal about the third day, with amelioration of symptoms. All symptoms recur in 12 to 72 hours. The second febrile period lasts two or three days, terminating by crisis. Profuse sweating, epistaxis and diarrhea are common at this time. The crisis is heralded by the appearance of a morbilliform rash which begins on the dorsal surface of the hands and feet. This eruption may spread to all parts of the skin. In some cases it may be punctate, resembling a scarlatinal rash.

The case incidence of these symptoms varies in different epidemics and in different individuals. In some cases, the rash will be transient, in others the temperature will be remittent not 'saddle back': adenopathy may be absent or very marked. The mortality is low. Convalescence is usually protracted, one to three weeks, and is associated with marked mental depression.

Treatment

There is no specific treatment. General care and symptomatic treatment are indicated.

Control of Dengue

1. Eradication of the *aedes* in and around camp should be attempted.

   a. Institute thorough policing of the camp once a week for *aedes* breeding places, giving special care to tin cans, oil drums, tire casings, roof gutters, rain barrels, and coconut husks.

   b. Wells, water cisterns and rain barrels should be made permanently mosquito-proof. When this is impossible fuel oil should be poured on the surface of the water.

   c. Thorough check inspections by the medical officers are essential.

2. Screen all buildings with 18 mesh wire.

3. Personnel sleeping during the daytime must use fine mesh bed nets.

4. Isolate patients in screened wards and under bed nets for four days from the onset of symptoms.

5. Spray the quarters where infection may have occurred.

APPENDIX

BLOOD FILMS FOR MALARIA

Laboratory Technic

Specific diagnosis is made by demonstration of the plasmodia in blood. In each suspected case, examine the blood as soon as possible, preferably by thick smear. Thin smears should also be taken for use when species diagnosis cannot be made in thick smears. If malaria parasites are not found, take smears on successive days, because the symptoms in persons suffering from a first attack may be initiated by a low density of parasites, and because in falciparum infections there may be very few parasites in the circulating blood during the second twenty-four hours of each asexual cycle. Suspect as malaria infection all febrile illnesses occurring in endemic areas; suspect a recurrence or relapse in all who give a history of previous malaria.

1. *Thick smears.* -- The surface at the end third of a clean and grease-free slide is placed in contact with the crest of a drop of welling blood and gently rotated thereon without touching the skin, until the blood is smeared over a circular area about the size of a dime. Allow the smear to air dry in a horizontal position protected from insects and dust. Dry thick films may be stained by the Giemsa method or with Field's stain, if available. They should not be called negative until carefully examined for five minutes.

Dilute Giemsa stain is used, one drop of the stain to 1 c.cm. of water. Slide is covered with stain for 20 to 30 minutes, washed in water and allowed to dry without heating or blotting.

Field's stain is applied for one second, and differentiated in clean water for 5 minutes.

2. *Thin smears.* -- Stain with Wright's or Giemsa's method. Should not be called negative until carefully examined for fifteen minutes.

3. In P. falciparum infections, estimate the proportion of infected erythrocytes if possible. If 5 percent or more erythrocytes are infected, treat as you would a comatose patient. In P. falciparum infections the demonstration of parasites in the blood is difficult at times, even in the presence of a severe infection with cerebral symptoms, including coma.

PART II
FOOD AND WATER

Food and water are the agents for transmission of gastro-intestinal infections. These diseases are important in all climates, but in the tropics and subtropics fecal contamination of food and water is such that gastro-intestinal infections rank second only to malaria as a military medical problem. Immunizations against typhoid and cholera, combined with sanitary measures, have been effective in prevention of these diseases, and future epidemics of military significance are improbable. Immunizations against bacillary and amebic dysentery and non specific diarrhea are not available. Since sanitary measures are the sole means of control, major epidemics may be expected whenever and wherever these measures are relaxed. The diseases here considered are bacillary and amebic dysentery and non specific diarrhea.

DIARRHEAL DISEASES

I. Transmission

General sanitary measures in the tropics and subtropics are nonexistent except in some of the larger cities, where there is efficient sewage disposal and a safe water supply.

Surface water, whether in streams, wells, fountains, irrigation ditches or cisterns, is to be considered unsafe for consumption. Articles of food and drink made from water sold in native bazaars or markets are similarly unsafe. These include ice, ice cream and soft drinks.

Raw foods, especially vegetables and fruits, purchased by individuals or for the use of the mess, are likely to be polluted, since in many areas human feces is used as garden fertilizer. These foods include fresh salad greens, lettuce, celery, radishes, carrots, and strawberries, for which personnel may develop a considerable craving. Vegetables and fruit grown in unpolluted soil may become infectious from having been washed in polluted streams or irrigation ditches. Fruits with thick skins are safe provided the skins are intact and the fruit not decayed. Watermelons may be contaminated by the native practice of soaking the stems in water to increase the weight by imbibition.

The important role of flies in transmission of diarrheal diseases cannot be overemphasized. Seasonal incidence of the diar-

rheas parallels that of flies, but where flies are permitted to be a constant pest, a consistently high morbidity may be expected. Flies feed impartially on feces, decaying matter and human food. Many organisms are transmitted on their feet. Organisms are ingested by them and deposited in their droppings; even viable *E. histolytica* cysts have been found in fly feces.

The ultimate sources of infection are patients suffering acute or chronic attacks of diarrhea and dysentery, and carriers.

2. Incidence

The incidence of bacillary dysentery will be slightly less than that of non specific diarrhea, but greater than that of amebic dysentery in all subtropical and tropical theaters. Incidence will follow carelessness in matters of hygiene rather than a seasonal or geographical pattern. An epidemic may occur with great suddenness and to an extent which will paralyze military operations.

3. Classification

Non specific diarrhea includes those cases in which blood does not appear in the stools.

The term dysentery includes cases in which blood and mucus appear in the stools. Dysentery may be bacillary or amebic.

Medical officers may not have laboratory facilities, and diagnosis will perforce be clinical. This discussion is not intended to give more than a brief clinical picture of typical cases.

4. Symptomatology

a. Non specific Diarrhea. This is characterized by an explosive onset, with abdominal cramps and diarrhea, often with vomiting and some prostration. There is little or no fever, and toxic signs are slight. The stools are usually watery, rather copious, contain no blood and but little mucus. They may number from a few a day to twenty or more. The course is usually short, averaging three days, rarely six. The mildness of the course should not obscure the fact that many of the non specific group are, in fact, bacillary dysentery, with the epidemiological significance which this fact connotes. Nor should one lose sight of the fact that the non specific diarrhea has the same relationship to lack of hygienic precautions and to impairment of military strength as bacillary dysentery.

b. Bacillary Dysentery. The milder the attack, the more gradual

is the onset. The full picture, gradual or sudden in onset, is characterized by cramplike, colicky abdominal pains, temporarily relieved by passage of a diarrheal stool. The pain is periumbilical; tenderness is characteristically found in the left iliac fossa over the descending colon. The stool is typically watery at first, becomes scantier, more frequent, (10 to 20 a day) and blood-stained. In severe attacks there is tenesmus and the entire stool may consist of bloody mucus. In such cases there may be 20 to 40 stools, within 24 hours; the temperature, normal or low in mild cases, rises abruptly to 104°F. or higher in severe cases.

c. Amebic Dysentery. In about half the cases the onset is acute, with colicky abdominal pain and frequent loose movements. Stools may number 15 to 30 or 40 a day, usually containing some fecal matter in addition to blood and blood-stained mucus.

The mild attack begins insidiously, and may for a long time go undiscovered. Fatigue and mild abdominal discomfort may be the only symptoms. Moderate diarrhea may alternate with constipation. The course can continue for months in this stage, may clear up entirely, or may become more severe. Only in the latter case does the diarrhea become prominent, with blood and mucus in the stools. Latent or mild cases usually show a suggestive abdominal tenderness.

Roughly 20% of the cases of acute amebic dysentery are complicated by liver abscess. This complication may occur during an acute dysentery or after months in a chronic case. In 60% to 90% of cases, a history of dysentery may be obtained. Liver abscess cases are characterized by weakness, low grade fever, chills, anorexia, and pain in the right lower chest, right upper quadrant, or right shoulder. Jaundice is unusual. Enlargement and tenderness of the liver are found on examination.

5. Diagnosis of Dysentery and Diarrhea

Exact diagnosis on an etiological basis can be made only when both laboratory facilities and trained personnel are available. Many cases will be considered to be "non specific diarrhea" which are, in fact, potential sources of an epidemic of bacillary dysentery.

In the absence of laboratory facilities, differential diagnosis must be made on clinical findings. As an indication for specific treatment, the observed characteristics of the stool are of greater importance than the general symptoms and history.

The table below indicates the differential characteristics of stools in typical cases of moderate severity.

	Bacillary Dysentery	Amebic Dysentery	Non Specific Diarrhea
Blood	++	+	○
Pus	++	±	○
Mucus	++	+	+
Fecal Matter	+	+	++
Fluidity	+	±	++

Fulminating attacks of bacillary or amebic dysentery are virtually indistinguishable without laboratory study. A therapeutic test, useful when no laboratory facilities are available, is the striking and sometimes complete symptomatic relief occurring in 24 to 48 hours when a patient with acute amebic dysentery is given emetine hydrochloride 0.06 gram (1 grain) subcutaneously on 2 successive days. In areas where malaria is hyperendemic the dysenteric onset of malignant tertian malaria may cause diagnostic confusion, because of its similarity to severe dysentery. Asiatic cholera may be distinguished by the copious watery stool, which contains no blood, pus or fecal matter.

6. Treatment

1. *GENERAL*

a. Complete bed rest is indicated and will shorten treatment in all but the mildest ambulatory cases.

b. Food should be withheld until it can be tolerated, when a gradual return to normal diet can be begun. High protein foods are indicated.

c. Relief of dehydration and acidosis or collapse may require intravenous saline, plasma or transfusion.

d. Four multivitamin capsules daily should be given in most cases during convalescence.

2. *SPECIFIC*

a. Bacillary Dysentery

(1) Sulfaguanidine (or Sulfasuccidine) 3.5 gm q.4 hr. until stools are reduced to 5 per day; then q.8 hr. for 3 days. (Such dosage will require 60-65 gms for 5 days treatment, or 125 0.50 gm capsules.) Smaller doses than this may be tried if the supply of sulfaguanidine is limited.

(2) Sulfathiazole, or sulfadiazine may be used if there has been no improvement in 5-7 days of sulfaguanidine treatment, provided fluid intake is maintained to provide a urinary output of 1500 cc.

(3) The possibility of the dysentery being amebic should be remembered.

b. *Amebic Dysentery*

(1) Emetine hydrochloride 0.03 gm b.d. intramuscularly for 4 to 6 days. Toxic effects (lowered blood pressure and vomiting) are unlikely to appear in this time. Stop emetine when dysenteric symptoms subside.

(2) Carbarsone 0.25 gm t.i.d. by mouth for seven days concurrently with emetine.

(3) Follow carbarsone by
(a) Vioform 0.25 gm t.i.d. by mouth for 7 days, or
(b) Diodoquin 0.60 gm t.i.d. by mouth for 7 days.

(4) Retention enema nightly for 5 nights, using carbarsone 2.0 gm in 200 cc. of 2% sod. bicarbonate solution if symptoms have not been relieved by other treatment.

7. Prevention (cf. FM 8-40. AR 40-205. AR 40-210.)

All food and water used by military personnel must be free from contamination. Included are articles purchased from native sources for the mess or for individual use; water used for washing and brushing teeth; and cooked food which may have been exposed to flies. The supervision of control measures rests with medical officers.

Control of food and water may be effected by:

1. *STERILIZATION*

a. Chlorination. *E. Histolytica* cysts are not killed by concentrations of chlorine ordinarily advocated, but the majority will be killed by a double concentration after a 20 minute exposure.

b. Boiling.

c. Cooking.

(1) Storage of uncooked foods may be unsafe because of rapid spoilage and contamination by flies. If practicable, enough food for only a single meal should be prepared.

(2) All food should be protected from flies.

Control of flies

The role of the housefly in the spread of diarrheal disease can hardly be overemphasized. Control should be directed against the breeding of flies, toward the elimination of the fly from the kitchens, messes, and quarters, and the prevention of contamination of food by them. This includes:

1. Prompt and proper disposal of garbage and organic wastes.
2. Construction of sufficiently deep and fly-proof privies.
3. Proper policing of the camp site.
4. Screening of kitchens and mess.
5. Use of flytraps and swatting.
6. Screening of food in dishes, etc.

Control of Cases and Carriers is dependent upon recognition of the disease, and proper treatment. Concurrent disinfection should be practiced. Persons suffering from gastro-intestinal symptoms, and carriers, should be removed from positions as food handlers.

APPENDIX

STOOL EXAMINATION

Laboratory Technic

1. Microscopic Examination

Specimens should be collected in clean, covered receptacles and examined immediately. If the stool is solid, search for small flecks of blood or bloody mucus on its surface; liquid stools will always contain small amounts of mucus and blood. Place a loopful of mucus or mucus and blood on a warmed glass slide, and emulsify with a drop of physiological saline. Cover with a cover-slip and examine fresh, or stain with Loeffler's methylene blue, 1% aequeous cresyl blue, or 1% aequeous neutral red.

A bacillary dysentery stool smear will show blood in varying amounts, usually abundant early in the disease. Characteristically there are large numbers of pus cells, 90% being degenerated leucocytes, and some large macrophages which may contain red blood cells. The latter are not motile, and should not be mistaken for amebic trophozoites. Amebic stools show numerous red cells, often clumped and degenerated, and very few pus cells or phagocytic cells. The presence of amebae establishes the diagnosis.

It is almost impossible to find amebae in a stool after an oil cathartic or following an enema. The chances of finding amebae are usually increased after saline catharsis, however.

It is often productive to examine the scrapings of the rectal wall. This is done either by direct vision through a proctoscope, or by passing a rubber rectal tube and examining the mucus caught in the tip.

The diagnosis of amebic dysentery should not be made without laboratory substantiation.

2. Cultures

Bacteriological proof of the various types of bacillary dysentery requires skilled technicians and complex methods. Reference should be made to TM 8-227, Methods for Laboratory Technicians. Such services may be rendered by neighboring Army Service Forces hospitals or mobile laboratories.

PART III

BREAKS OF THE SKIN SURFACE
AS A ROUTE FOR SEVERE SKIN INFECTIONS

It can be stated as a practical principle that untreated or improperly treated scratches, abrasions, insect bites and minor lacerations sustained in the desert or tropics will become infected. Newcomers to the desert and tropics simply will not believe that the trivial injuries which healed so promptly at home will not do so in their new, highly contaminated environment. It is these breaks in skin continuity and the complications arising therefrom which are discussed.

Predisposing Factors and Prophylaxis

1. *ENVIRONMENT*

Rough thorny cover and rocky terrain materially increase the probability of incurring minor scratches and abrasions. Biting insects or parasites, mosquitoes, fleas, ticks, leeches and so on, are present in most areas. Not only does the scratching of their bites initiate many infections, but the bites themselves act as portals of entry for infection. The men show a tendency to wear as little clothing as possible, but long-sleeved shirts, long trousers and leggings should be worn as protection against inhospitable cover and against insects.

The dryness of the desert heat may cause fissures in the parched skin into which sand may be blown or rubbed, setting up foreign body reactions. The dangers of infection and foreign body inclusions are materially lessened by properly protective dressings.

In moist tropic areas, maceration of the skin is a constant hazard, especially because of prolonged use of wet clothes or shoes. Maceration may be minimized by frequent changes of socks and underclothing, frequent baths, and the generous use of GI powder on the feet and in the skin folds.

2. *PERSONAL HYGIENE*

Experience has shown that the "dirty" individuals of a command suffer more complications than do those whose hygiene is more rigidly maintained. Personal cleanliness and regular changing of clothes should be made the subject of orders, and disciplinary action taken if necessary.

3. *FIRST AID*

It has been demonstrated repeatedly in groups where minor scratches, abrasions, and bites are neglected, that the incidence of infections, ulcerations and sores approaches 100%. Indoctrination of all personnel with the idea that even the most trival break in the skin must receive immediate attention is of paramount importance. The Medical Officer must use every means at his disposal to insure that proper first aid measures are carried out promptly and in detail.

First Aid Measures

1. *SUPERFICIAL ABRASIONS, INSECT AND LEECH BITES*

Immediately upon injury, tincture of iodine (tincture of benzoine or aqueous silver nitrate) is applied and the lesion covered. This may be done by the men themselves, but such cases should be reviewed at regular intervals as the men tend to minimize or fail to recognize early signs of infection.

2. *MINOR LACERATIONS*

The skin around the laceration is cleaned with soap and water, or a weak lysol solution; the wound is swabbed with normal saline, and one (1) or two (2) grams of sulfonamide powder is dusted in. The area is covered with a small gauze pad spread with zinc oxide ointment and the whole occluded by elastoplast or bandage. The dressing should be undistrubed for 1 to 5 days depending on soilage, perspiration, etc.

Complications of Minor Injuries to the Skin

1. Infected cuts, abrasions and bites
2. Furunculosis
3. Desert sores
4. Tropical ulcers

The complications of minor injuries of the skin in desert and tropic areas have three things in common: (1) most of them occur with great frequency; (2) they have a strong tendency toward chronicity and indolence in healing; and (3) they require early and vigorous treatment. Military necessity will weigh heavily in the decision as to when and in which cases ambulant treatment will be employed. Rest is always helpful and frequently essential in the treatment of these lesions. In ambulant

cases particularly, immobilization of the part by the use of light splints and slings is eminently worth while.

1. *INFECTED CUTS, ABRASIONS AND BITES*

Most improperly treated wounds become infected 12 to 36 hours after the original injury. Those actively inflamed but showing no extension are treated in the same manner as uncomplicated minor lacerations. When acute spreading infection is present the usual treatment of rest, moist heat and elevation is advocated. Fluids are forced and sulfonamides given as indicated.

2. *FURUNCULOSIS*

The treatment of boils and carbuncles in the desert and tropics is essentially the same as in temperate regions, with this exception: the rate of autoinoculation is high, and great care in dressing is necessary to avoid serial infection.

3. *DESERT SORES (Veld Sore, Barco Rot, Tropical Service Ecthyma, Pyodemic Ulcerosum Tropicalum, Impetigo Contagiosa, etc.)*

The diagnosis of desert sore is not definite but has come to include practically any sore or ulcer appearing in desert stations. In general, however, the lesions fall into two groups: (a) the common staphylococcal and steptococcal dermatoses, which also occur frequently in tropical theaters; and (b) the infrequent "textbook" desert sore.

a. The clinical appearance of the staphylococcal and streptococcal dermatoses is too well known to warrant redescription here.

Of the sulfonamides used locally, sulfathiazole has given most consistently satisfactory results.

The preparation of the lesions is important. The epithelium is removed from vesicles and pustules, scabs and crusts are soaked off, and the lesion carefully cleaned. In the less severe cases, sulfathiazole powder or a five percent (5%) to ten percent (10%) ointment in a water soluble base is applied directly, and the area occluded with elastoplast or bandage. The bandages are disturbed as infrequently as possible. In the more severe cases, the lesions are cleaned in the same manner, liberally dusted with sulfathiazole powder, and the entire part covered with a warm moist pack. Cases proving refractory to sulfathiazole alone will frequently respond to the following formula, which may be used as powder, mixed with water and used as a wet pack or incorporated in a paste: sulfathiazole one (1) part, lactose, two (2) parts and urea five (5) to seven (7) parts.

b. The "textbook" desert sore appears in two varieties. In the first, the lesion starts as a small vesicle which soon breaks down to form a spreading erosion. Pain is more marked than would be expected. In two or three weeks the lesion has become a chronic punched-out ulcer, the base covered with a dirty grey deposit remotely suggestive of a diptheritic membrane.

The second type occurs more commonly in debilitated personnel. It starts as a dry, angry looking erythematous spot, soon surrounded by a ring of vesicles beyond which is an encircling inflammatory areola. Within a few days the area within the ring of vesicles has become a dark gray to black diptheroid membrane overlying fungating granulations and covered by greenish yellow pus.

Klebs-Loeffler bacillus may be isolated from most of the lesions in non-immune personnel.

When Klebs-Loeffler bacillus is found, the specific treatment is local injection of at least 4,000 units of antidiptheritic serum. However, since many lesions are grossly contaminated, additional treatment as recommended for the coccal dermatoses, is usually necessary to effect a cure.

4. *TROPICAL ULCERS (Tropical Sloughing Phagedena, Naga Sore)*

The tropical ulcer is a chronic sloughing ulceration of the skin, usually appearing as a complication of trivial but untreated wounds. It may begin as a small circumscribed papule which soon becomes inflamed and ulcerated. The lesion extends rapidly both in diameter and depth. This process is not necessarily limited by the deep fascia. The ulcer margins are slightly elevated and may be undermined by deep and troublesome pockets. The floor is often covered by dirty necrotic plaques, and the discharge is both copious and offensive.

Sloughing may cease in one or two weeks, or the process may go on to invade the deeper structures. In the former circumstance, the general reaction is mild, with some fever, moderate pain and vague constitutional disturbances; but in the latter, toxemia, sepsis and exhaustion may be profound. The lesions tend to be multiple because of autoinoculation into any coincidental abrasion or scratch.

The etiology is not clear, although the Fusospirochaetes of Vincent are consistently recovered from most uncomplicated ulcers and frequently may be demonstrated in the more heavily contaminated lesions.

Death from tropical ulcer, although uncommon, is not unknown.

Treatment

a. *GENERAL*

(1) Strict bed rest, full diet and high fluid intake are essential.

(2) The general condition of many of these cases is poor. The recognition and treatment of concurrent malnutrition and subclinical avitaminosis is essential to the success of any regime.

b. *SPECIFIC*

(1) Arsenicals. Intravenous administration of mapharsen or neoarsphenamine is effective in standard antisyphilitic doses.

(2) Antimony. Various antimony salts, although considered the drugs of choice in some areas, have not enjoyed wide acceptance. For intravenous administration, urea stibamine (obtainable in India at Brahmachari) dissolved in 10cc. of 25% glucose is given on alternate days in the following doses: 0.05 gm, 0.01 gm, 0.15 gm, 0.2 gm. 0.2 gm is considered an adequate maintenance dose. The injections are to be given in the morning before breakfast.

c. *LOCAL*

(1) The ulcerated extremities are splinted and elevated.

(2) Local treatment should be carried out twice daily: when discharge and inflammation are marked, the ulcers are given a one-half hour warm moist pack. The lesions are then carefully cleaned with a mild antiseptic and the contiguous skin swabbed with alcohol. When arsenicals are used intravenously, gauze pads saturated with 0.3 percent mapharsen or 3.0 percent neoarsphenamine solution are placed over the lesions, covered with oiled silk or waxed paper, and the whole part encased in a padded pressure bandage. When antimony is used intravenously, local two percent (2%) to four percent (4%) tartar emetic ointment is applied instead of the mapharsen and neoarsphenamine packs. The strength of ointment depends on the skin tolerance.

(3) Alternative treatment: in selected cases, when the response to local arsenicals is unsatisfactory, daily dressings with powdered normal plasma frequently result in

rapid improvement. Intravenous medication should be continued. This method is to be reserved for the infrequent refractory case, as supplies of dried plasma are distinctly limited.